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(54) METHOD OF TREATMENT OF TOOTH HARD TISSUES BY LASER RADIATION AND DEVICE FOR ITS REALIZATION

(57) Abstract:

FIELD: medical equipment, applicable in stomatology at treatment of caries and dental prosthetics. SUBSTANCE: the method consists in action of laser pulse on the tooth tissue, pulse intensity of light radiation of tissue treatment products is detected, and the type of tissue to be treated is determined according to the pulse peak amplitude. The device uses a pulsed laser and means for delivery and focusing of laser radiation arranged in succession in the optical axis, photodetector whose input is optically integrated with the focusing system focal plane, and an electric pulse amplitude meter, whose input is electrically coupled to the photodetector output, and the output is electrically coupled to the display unit input; the photodetector is installed in such a manner that the direction of its maximum sensitivity makes up angle α with the direction of the optical axis at the output of the focusing system: this angle satisfies condition $\alpha > \arctg(D/2f)$, where D - clear aperture of the focusing system output window, and f - its focal length. EFFECT: reduced danger of laser injury to patient. 6 cl, 5 dwg6

Y1306pe reHHe OTHOCHITCA K Mc,E(HHHHCKOfTeXHHKE H MoJKeT 6bITb LICHOn30BaHO B CTOMATOJIOPIHH npH ne^{1e}HHH Kapyca H npOTe3HpOBaHHH 3y6OB. OCHOBBHIM HejIOCTaTKOM H3BeCTHbIX cHoco6OB o6pa6OTKH TBepHbIX TKaHcT^{3y6a} Ha 3epHJIM H3JIT^{1e}HHeM H yCTpocTB, pearH3yIOy Mx 3TH Cn0006bI, HBJaeTCa BbICOKaB oHacHocTb HaHeCeHHa Ha 3epxO TpaBMbI nau,HeHTy. 3aayefi, Ha pelleHHe KOTOpOI HaHpaBHeHO oasBJineMoe H306pCTeHHe, HBAETCA CHYKEHHc oHacHOCTH HaHeCeHHa HaHCHCTy Ha 3epaoJI TpaBMbI 3a cTeT o6eHeTeHHH B03MOIKHOCTH onreHeHHH THHa o6paMMaMoI TKaHH. YKa3aHHa5 3aJZaua, r oTpacTeCH TeM, TTO B cHoco6e o6pa6OTKH TBepjblx TKaHeft 3y6a Ha 3epHbIM H3ny^{1e}HHeM, BKInouaIOy eM Bo3JeficTBHe Ha TKaHH 3y6a Ha 3epHopo HMmpH,ca, perCTpHpyIOT HHTeHCHBHOCTb HMnHbCa CBeTOBOPO H3ny^{1e}HHH npOHKTOB O6pa6OTKH TKaHH, HO HHKOBOMy 3Ha^{1e}HHIO KOTOpOPO onpej:enmoT THH o6pa6aTbBaEMOI TKaHH. YKa3aHHaI 3a);aJIa TaKKe JTOCTHraeTCa TeM, TTO yCTPOICTBO ;vIM o6pa6OTKH TBepjblX TKaHeft 3y6a Ha 3epHbIM H3ny^{1e}HHeM, COCTOAT:ee H3 HOCTe oBaTenbHO paCHOJIOKeHHbIX BHOHb OHTH^{1e}CKOII OCH HMJInbCOPO Ha 3epa, a TaKKe cpegTba J;OCTaBK H)OKyCHPOBK H 3epellopo H3ny^{1e}HHA, COHej;KHT TPOTOnHeMHKK, BXOJ KOTOpO OHTH^{1e}CKH COHPH)KCH c 40KanbHOLI 1HOCKOCTbIO 4 oKycMpyIOy efi CHCTeMbI, H H3MepHTCb aMHTHTy6bI 9nCKTPH^{1e}CKHX HMInbCOB, BXOJ- KOTOpOPO 3HeKTPH^{1e}CKH COHPAHCH c BbIXOHOM TPOTOnLLeMIIHKa, a BbIXOJ; 3HeKTPH^{1e}CKH conp5 Kell co BXOHOM yCTPOICTBa HH) HKaHHH, JI^{1e}Me (pOTOnHeMHKK yCTAIOBHeH TaKHM O6pa3OM, LITO HaHpaBHeHHe ero MaKCHManbHOI TyBCTBHTeJIOCTH COCTaBpeT c HaHpaBHeHHeM OHTH^{1e}CKOfi ocn Ha BbIXOie 4oxycHpyIOtefi eHCTeHpbI ania, y)IOBHeTBOPHIO3HaT yCBOBHIO a >arct(D/2f), rJie D - cHCTO3ofi jHaMCTp bXOHIIOpO Dada (poxyclpyIOJlJlefi CHCTeMbI, a f - ee (4OKYCHOC pacCTOAHHe. 2. c ii 4 3.n.t., 5 rm.

Description [Onmcarne H3o6peTeHHsi]:

L13o6peTeHae OTHOCNTCA K McJ uU1HCKOLI TeXHHKe H MOZKCT 6b1Tb HCHOnb3OBaHO B CTOMaTOJIOpM.

1/b3BeceH cnoco6 yjjaneHNA HauanbHbIX KapBO3Hb1X nOBpe?Iq eHn 1 H/Hnn KaMHC 1 3y6a (naTeHT USA 4521194, A 61 C 05/00, npHopBTET 22.12.83), BKrloulalonin o6pa6oTKy TBCp) bIX TKaHCL 3y6a HMNynbCHbIM na3CpHbIM Li3JlyeHHeM. OCHOBBIM Her OCTaTKOM jjaHHOpO cnoco6a ABnHeTCA BbICOKa\$ OnaCHOCTb HaxeceHHA na3epxog TpaBMbl npH o6pa6oTKe TBepjibIX TKaHe» 3y6a.

HaM6onee 6nN3KHM no TexHHUecxoil cynioCTH # ПpHHATbIM 3a npOTOTH ABNACTCA cnoco6 neuenns **HeOCTOKHeHHOpO** KapHeca (a.c.CCCP N 1593669, A 61 C 5/00, npHopwreT 14.11.85, ony6n. 23.09.90 BUI N 35). BKnloulaloluxil o6pa6oTKy TBepjiblx TKaxe 1 3y6a na3epHbIM H3JIMMeliNeM c **jjHHOI4 BonHbl** 2,94 MKM, j[naTenbHOCTbIO NMIIynCOB 100 500 MKC, **MOHJOCTI,10 .0,5 1,0 Z(7K/HMn, IIJIOHOCTbIO MOIAHOCTH** $2 \cdot 10^4 + 3 \cdot 10$ BT/CM2, ²**iaCTOTOLI 1 fLL. 3KC1103anx4e2 3-30 c. OCHOBBIM HegOCTaTKOM npOTOTHna** HBIACTCA onacHocrb **HaneCeHHH na3epHOI** TpaBMbl npH o6pa6oTKe TKaHeii 3y6a, **CB013anHaa C** OTCTbCTBHeM B npOTOTHTC npouejyibi onpejjeneHNA Tana o6pa6aTbIBaeMOLI TKaHH.

IR3BeCTHO yCTPOLICTBO jinn o6pa6oTKH TBepjibIX TKaHevl 3y6a **na3epHbIM** 143nyIeIneM (naTeHT WO 89/08432, A 61 C 5/00, npHopHTET 10.03.89), **BKnloulalonjee nocneJoBaTenbno** **pacnono}KeHbie BJ[Onb OHTHLeCKO\$ OCN HMnynbCHbl\$ na3ep H CpejicTBO jiocTaBKN** 1437ly⁴ICHN1 K 3y6y B BNjic ofTHUeCKOpO BonoKHa. OCHOBBIM HCjicTATKOM jjaHHOpO yCTPOLICTBa ABnIeTCA BbICOKaH OnaCHOCTb HaHeCeHHA na3epHOI TpaBMbl npH o6pa6oTKe TBepjibIX TKaneli 3y6a.

HaH6onee 6nH3KHM no TexHHUecxoil CyWjIOCTH H npHHATbIM 3a npOTOTH HBJICaTCA yCTPOICTBO jinn o6pa6oTKH TBepjibIX TKaHe}I 3y6a na3epHbIM **H3JlyerneM** (naTeHT WO 90/01907, A 61 C 5/00, npnopHTET 25.08.89), cojje7Kanee nocnejjosaTenbHo pacnono KeHHble BjjOnb onTHUeCKO2I oca **aMIIynbCHbIYI** na3ep, a TaK,Ke cpejicTBO jiocTaBKH 14 4OKYCNpOBK14 na3epxop LI3ny4eHa5, HKJIOUa!Onjee OTpe3OK onTN⁴leCKOpO HOJIOKHa, BXOJ **KOTOpOpO onTlyecKa** conpSijKeH c BbIxojOM na3epa, N **(pOKycapyloljero CaCTeMy, BXOjj** **KOTOpOYI OHTIMECKH CONPM7KeH c BbIXOjjOM OHTN⁴leCKOpO BOnOKHa, a BbIXOjj AHNHCTCH** **BbIXOjjOM yCTPOLICTBa. OCHOBBIM HegOCTaTKOM npOTOTana ABnBeTCH OnaCHOCTb** **HaHeCeHHA** na3epHON TpaBMbl npH o6pa6oTKe TKaHet 3y6a, **CBA3aHHas c OTCTbCTBHeM B** **npOTOTHne CNCTeMbi** onpejjeneHnn Tana **o6pa6aTbIBaeMOLI** TKaHN.

3ajjauei4, Ha peuteHne KOTOpOI4 HanpanneHo 3a **IBnxemoe N3o6peTeHne, CIBnneTCH** **CHLUKenne OnaCHOCTLI** **IlaHeceHas nan, MenTy** na3epnoLI TpaBMbl 3a cueT o6eue ⁴**TeHaH** **B03MO2KHOCTH** onnc enelins Tana o6pa6aTbIBaeMOLI TKaHN.

YKa3aHHaH 3ajja⁴ia jiocTNraeTcH TCM, ⁴ITO B cnoco6e o6pa6oTKH TBCpjjbIX TKaneli 3y6a na3epHbIM H3nyeHHeM, BKnlolalonjeM B03jjeLICTBHe Ha TKaHN 3y6a na3epnop aMnynbca, **peraCTpapyloT 14HTeHCNBHOCTb NMIIynbca CHeTOBOpO** **III3JlyeHHA npOjjyKTOB** o6pa6oTKH TKaHN, no **naKOBOMy 3Ha⁴TeHpo KOTOpOYI** onpejjen5loT TIM **o6pa6aTbIBaeMOLI** TKaHN. Ans **IOBbIIIJCHNH jiocTOBepHOCTH** onpejjeneHas Tana o6pa6aTbIBaeMoi TKaHN **HHTeHCHBHOCcb** **yKa3aHHOpO CHeTOBOpO 1/13nyeHHA** **perNCTpmpylOT B CnCKTpaJIBHOM jjaana30He 350 500** **HM. C ToI4 7Ke Ijellbio o) HOBpeMeHHO c** **peracTpaijMei NHTCHCNBHOCTH HMTIynCa CBCTOBOpO** **H3ny⁴TeHHA** **n3Mep5noT BpeMeHHylo 3ajje7KKy Me}Kjj}* na3epHbIM N CBeTOBbIM** **Tdl nlynCaMLI, no BCTINUNHe KOTOpOIl yTO⁴nimIOT TIIM** o6pa6aTbIBaeMOLI TKaHI4.

YKa3aHHas 3ajja⁴ia TaK7Ke jiocTHraeTcs -rem, uTO yCTpoiCTBO jina o6pa6oTKH TBepjiblx **TKaHei 3y6a na3epHbIM H3Jly⁴TeHHeM, cocTosjee 143 nocnejjosaTenbno pacnono7KeHHbIx** **BjjOnb onTN⁴leCKOI OCN HMnynbCHOpO** na3epa, a TaK7Ke cpejicTBA J(OCTaBKN H 4)OKYCHpOBKN na3epHOp 113ny⁴TeHnH, COjje7KNT **(pOTonHeMHKK, BXOjj KOTOpOpO onTN⁴leCKN CONPHvKeH C** **Y4OKanbHOI4 mOCKOCTbIO 4oxycilpylolgefl CNCTeMbl, H 143MepNTenb aMHnHTyjibl** **3neKTpN⁴leCKNX LIMIIynCOB, BXOjj KOTOpOpO 311eKTpH⁴CKKN CONPH7KeH c BbIXOjjOM** **ItoTonpHeMHKa, a BbIXOjj 3neKTpN⁴leCKN 00npSIKCH co BXO OM yCTPOLICTBa aHjjIKaUMH,**

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 'KHHabArgH O.IOHdagEU HH.Id3HE 11.LOOHLOIII 11Haodtc I4IfEgEM011 P1odh.LMHLL 9Z
 'Ia4 EH •(I) HUEIaa H (H) EHH,LHaf HaHanadgEd mdu X1111IoreMa Igoa '11x.I,o9Ed90 Ho.Lx.Cllodu
 ISHHah/CugH o.IOH0.L3H3 a034Ir mini H.L30HHHaHa,LH11 '(9) 4.LaOHXdaaoII ootwaaI4.La9Ed90
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 oaodo.Lox ²aidaHe 'KLIHaI'u&LIgH o.IOHdagEU o.IOH341A11aw E9Ag HHEX.L EH 11HlaratfgOH 1ldjj

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 .Laalt LIx.Logudgo ao.LaAfodu ISIIHar irgH o.Ioaos aaa IsLlhxaau3 ISEH4uad.Lxaau 'NtogEdgo
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 \$ EHMOUGH O,I0313ahm.L110 x0_gad.LO a14HHaxc0IroloHd OH^EUa.LEHOtlaauo Nmunrxcddalao 'Z AgA_g
 x Eda_gEU LO KHHahAUCH mlaB.Laotl NIoa.Iatlada o3 uaacaduo3 mxoahm.LUO o.Iodo.Lox t1oxi a
 'j dacul graxogIIAurw (g -amp z 3) ,Lmxcdatloa oa.L3Hod.L3A Ismua.Ladgo_gm I4udildo(2 f, •u oLj

'HoxaoxmdLln:
 EHECEAOU OHHOU3A g 'I.HId EH ExmHYIYamduo.Lo4 IILL30HHauaEduEH EWNIEd.IEHt[
 •HbEtiff io zaumad KHHaaalLLaott Nramaou3A IAI19PIHt(Oxg03H K3,LaRUH15 'aHHuo,L33ed
 aoHaAxo4 as ; E 'i^Ewaa,3ma Hallo1AdmaAxd2 EHHO o,I0Ht(0XI4a d,LaNlemtf Hoao.Laa3 Q
 atf.I 'QZ/a) aIE < E oaiouaA gm2nounsdoA,Lauaot(A E uo,IA x'm oaoaa v_Iatno1AdmaAxo4 atfoxi4a
 EH moo I30313ahH,L110 NlaHHaUHEdIEH 3 ,WISUHE,L303 H,Looh4Lra.LHa,Laa/Ch HOH^ELEI113MENI
 O.Ia aMHauauduaH :otmaouaA aztnoiadao.LaraotfA E uo.LC 14vta.Lazo HatuoAdaaAxo4 o foxi4a
 EH H30 HO5133hH.L110 PZOIIIHauaEdiIEH a .L3alfae L30a IILL30H4Ua.LHa.LOHah HOH4uENIm3MENI
 Oda OHHalaadUIBH O.Lh 'P10CEd90 IIHME.L HI4HHaLIUGHE.L3S 'xaHRIamduO.L04 oaaomaxcdatfoa
 'Ea,Iaaods,oA Kmt ada,mox mmHaLadgo_gm NIa71IKoaaaH a KELRaEuaitladu 'NIo_gEdgo WmxBJ,

'NIarIHaHAI_gH NII4Hda_gEU 3
 HHa taHatforlaEea adu EuaxE4 o.IOHHoncode Hd,LAHa a,Wxmu_goa aodo.Lox 'HHEM,L mx.Lo9Ed90
 ao.LxAtfodu amuahAU_gH aoao,Laa3 ,LaEtfbU0U aH MHHNIaHduO.LO(4 EH ,io.Le adLj •amHKO.taaad
 aoHaAxo4 as , a °I4vpaa.3ma gahtIolcdH31(xo4 auxo oJoHtloxI4a d t.aNrawtf HoaaLao a
 al:fa 'Og/Q)ADia < E oaiouaA HviluousoA.LauaotfA^A uo.iA I4i'4aLaaa HatnofAdmaAxo4 atfoxi a
 EH H30 IOx3ahH.LIIO I~rOHHauaEdiIEH a ,LaKUaE,LOOa E3lunnamduo,Lo4) ILL30H^EIraLma,L3aAh
 gOHgtfePZH3aapI aanatraaduaz Hu3a aanAuo nos, a 4,LHHuor^Pia OHxrovz amaoU.I3A
 33Hftau3011 •N O3 hAII Nli^Eitda_gEu a d a,L3HatfoNraaea m'edoa,ox 'muaxE4 o,I0HHOH_gOde H.L3Eh
 HO L ISHHahAII_gH QIOaO,Laaa BHPPOHduO.L04) EH KHHEdEUOU 4.LH,L3A1.101f aH H OH '(14Y4a.L3m3
 gaIIIOAdm3Ax0(b 4,L3Ox3ouu lsanquexo) HHEB,L ummanAugo HOHO_g a EMHHNramduaLO4
 aHHaECKduO3 aOxaah LUO q.LHhau0390 ox4UoSL aH ONUII(0X90OH '(HH,LHaf '4IENIe)
 aIHH,L as 90 oIIIIWIdO40HH O,IatIIA3aH 'IHEM.L Hx,LO9'ed90 ao,LxArtodu KHHahAuCH O.IOaO,I.aaa
 HIIIIEd taH.Iad Hirt ofh 'OHEcExou awado.Lad -Necadgo Nu4NIa&dauod,LHOxah KaLolanapI_ga
 HHEM,L Hx,LOgudgo ao,LiAtfodu lsnnahAuem o oao,Laaa d,Lxaua H 'LL30Ham3HO.LHH
 uma laHalomHEea oJoxa,L aLa,L4u Cead •i'Nrouaxa4 NIIHHHoafode a KaLaexaaadau
 xohAu LH4ndacair atlt 'xKJaeugO xa.L a as ax a m on '(1gr1aLom3 HalnolAdaaAxo4 m.LOOx3oIIU
 HOH9Irexo4I a) H)Logedgo mac a ox^uuo,L aH PlaIHahAUCH NII4Hdacau a LOIAHtaHatfovVHE_gs
 HHEM.L Ha,LOgEd90 I4,LxAtfodu NraHHahAlrem Nu nda_gEu 4HEX.L oiANraaa14,LEGad90

uyBCTBHTCnbHOCTM **coCTHRI** HeT C HanpaBTleHMeM onTII⁷leCKOLi **oCK** Ha BbIXOge 4OKycmpylonjeLi cLcreMbI yron 28°. BbIXofj 4oTollpleMBLtKa 9neKTpHuecKM COHnHAieH 9epe3 M3MepHTCnb aMnnMTygbI 9neKTpIIIleCKHX HMnynCOB (ocu innorpal) 119-8) **6 c** HHJE(MKaTOpOM 7, B Ka⁹ICCTBC KOTOpO Bbl6paH U,H4lpOBOi BOHbTMCTp B4-17.

gOHOnHMTCTbHO yCTpOICTBO COACEHKMT CneKTpaHbHbI\$I (I)HnbTp C nOn00Li np0RRCKannn **350 500** HM, BblOnHeHHbIa B BMJje nnoCKOnapannenbHOR nnaCTHHbI M yCTaHOBeHHbI⁷ TaKHM 06pa3OM, ¹*ITO CPO* BbIXOg OHTM'I CKM COHnHDKCH C 4OKanbHO\$I IAIOCKOCTbIO 4)oKycLipyLoujeYI CHCTCMbI 4, a BbIXOJ; OHTYIueCKH conp57KeH c cIIOTOnpleMHMKOM **5**.

Tax)Ke yCTpO ICTBO JIOpOIHMTCTbHO CojjeK KMT 4xYrOperLlcTpaTOp 10 I a 6a2e cpo roJ;Hoga 4 34, onTHUecKH conpHAieHHbIti C BbIXOJ;OM na3epa 1 II 9neKTpIL'ICCKH COHnHHCeHBbui\$ C OJJHHM H3 *BX0gOB* B3MC TenHi BpCMCHbIX LIHTepBaHOB **9** Ha 6a3e uLI4poBo\$I ocu,nnnorpa4)a C9-16. BTopoLI BXOJ; LI3MepWTen5 BpeMeHHbIX IIHTepBanOB 93ICKTpLIUeCKH ConpH7KeH C BbIXOJ;OM 4)oTonpneMHMKa **5**. Ha BbIXOJ;e H3MepLLTen\$ BpeMeHHbIX IIHTepBanoB 3aJ(ep KKa Memvey Ha⁴anoM na3epnoro HMnynba, pemc rpLipyemo 4)oTopeMCTpaTopOM, M Ha'anoM LIMnynba **CBETOBOpO** H3ny¹leHHM npOpyKTOB na3epxoll o6pa6o'rKH TBep,HO i TKaHH 3y6a, perlCTpnyemo 4oTONpLIeMnHKOM, npeo6paoyeTCH B 9neKTpH¹lecKLIILi *CLI* 'Han, aMnnMTyga KOTOpO nponopITHOanbHa BeIII¹IDIHe BpeMCHHOLI 3aJ{ep}KKH. Bbxo 143MCpMTCJH BpeMeHHbIX MHTCpBaJOB 97ICKTpIBeCKM COHnH⁷KCH C HH,HHKaTOpOM 7.

TaKMM 06pa3OM, Ha OCHOBaHMM BbIIDeL3nO?KcHHOpO 3aHBnHeMaH COBOKyIHOCTb npH3HaKOB B cnocoe M ycTpOICTBe n03BOH\$IeT peHIMTb 3a) a ⁴zy, a HMeHHO CHM3MTb OHaCHOCTb HaxeceHMH TpaBMbl nau ieHTy npM na3epno¹ ⁷ o6pa6o'Txe TBepJ;bIx TKaHeLI 3y6a npM neueHMM Kapaeca M npoTe3MponaHMM.

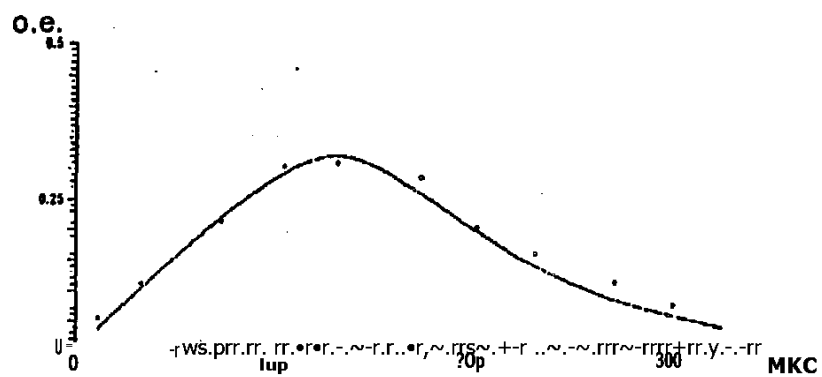
Claims [DopMyna R3o6peTern&®]:

1. Cnoco6 o6pa6oTKH TБepgjblX TxaHel' 3y6a YIa3epHbIM H3nyeHHeM, BKнIO'талонма Bo3geICTBHe Ha TKaHH 3y6a na3epxbxM HMnynbcOM, O'TnatlalonjHilci rem, rpo peraCTpHpyIoT HHTCHCHBOCTb HMHynbca CBeTOBOpO H3ny'leHHA npojyKTOB o6pa6oTKH TKaHH, Ho ИHCOBOMy 3Ha'leHHIO KOTOPO OИpejjenAлoT THH o6pa6aTbIBaeMOI TKaHИ.
2. Cnoco6 no n.1, o'Tnnua101glIfcg TeM, 'ITO HHTeHCHBOCTb CBeTOBOFO H3Jly'leHH3 perCTpHpyIoT B CneKTpanbHOM jHana3OHe 350 500 HМ.
3. Cnoco6 no n.1, or i'ialou iuilca TeM, 'ITO OjjHOBpeMeHHO C perCTpan,Heil HHTCHCHBOCTH HMИynbCa CBeTOBOPO H3nyeHHA H3MepIoT BpCMeHHyIO 3ajepZKy MC KJy na3epHBIMH CBeTOBBIMH HMИynbCaMH, Ho Be ИH'WHe KOTOPO\$ yTO'ИHAИOT THH O6pa6aTbIBaeMOI TKaHH.
4. YCTPOLICTBO NIB o6pa6oTKH TБepgjblX TKaHei 3y6a na3epHbIM H37IyеHHeM, cocpocin ee H3 nocлejjоBaTenbHO pacуono?KeHHbxx mom. OHTH'leCKOLI ocH HMИynbCHOPO na3epa, a TaK?Ke cpejicTba jjOCTaBKH H 4loKyCHpOBKH na3epHOpo H3ny'leHH5I, oTnHUALonjecca TeM, 'ITO OHO COjjeP3KHT IJИOTOnpHeMHHK, BXOjj KOTOPOPO OHTH'geCKH CONpAnKeH C 4)OKanBO\$ ИHOCKOCTbIO 4)oKycHpylonjeft exc'reMbI, H H3MepHTenb aMИИИHTyjjbl 3нCKTpH'ICCKHX HMnynbCOB, BXOjj KOTOPOPO 3неKTpH'leCKH CONpA}KeH C BbXOJ OM 4 oTonpHeMHHKa, a BbIXOjj 37leKTpH'ICCKH CONpH2KCH C BXOjjOM yCTpOИCTBa HHjjHKauLuH, yтw -IBM (J)OTOИpHeMHHK yCTaHOBHeH Tax, 'ITO HanpaBneHHe ero MaKCHManbHOИ uyBCTBHTCJИBOCTH COCTaBнeT C HanpaBneHHeM onTH'lecKoi OCH Ha BbIXOjje 4 oKycHpylonleik cmm-rem''' yron a, yjjOBneTBOpИHon(HVI yCJИOBHIO a > arctg(D/20, rje D CBCTOBOИ ,gHaieTp BbIXOjjHOpo OKHa d)oxycnpylonjek cHeTeMbI; f ee 4)oxycaoe pacCToAHHe.
5. YCTPOLICTBO no n.4, OTfHua1OИjecca TeM, 'ITO BXOjj 4OTOHpeMHHKa OИИH'leCKH CONpH}KCH C (4OKanbHOYI ИBIOCKOCTbIO 4IOKyclapyloujefa CHCTeMbI uepeo CneKTpanbHbИ @HабTp C HOHOCOLI npOИCKaHHA 350 500 HМ.
6. YcTpO ICTBO no n. 4, OTnH'alalolljeed TeM, 'ITO yCTpOYICTBO) onOnHHTenbHO COjjeP?KHT 4OTOperCTpaTOp H 6nOK H3MepeHHA BpeMeHHbIX HHTepBaJИOB, npHeM BXOjj ИOTOpernCTpaTOpa OnTH'leCKH conpxieH C BbIXO) OM na3epa, a BbIXOjj 3неKTpH'leCKH ConpH?KeH C Or HHM H3 BXOJXOB 6nox H3MepeHHA BpeMeHHbIX HHTepBaIOB, BTOPOИ BXOjj KOTOPOPO 31leKTpH'leCKH conp?KeH C BbIXOjjOM 4OTOHpeMHHKa, a BbIXOjj 91leKTp}I'leCKH ConpH}KCИ C BXOjjOM yCTpOИCTBa ИИ) ИKaИИH.

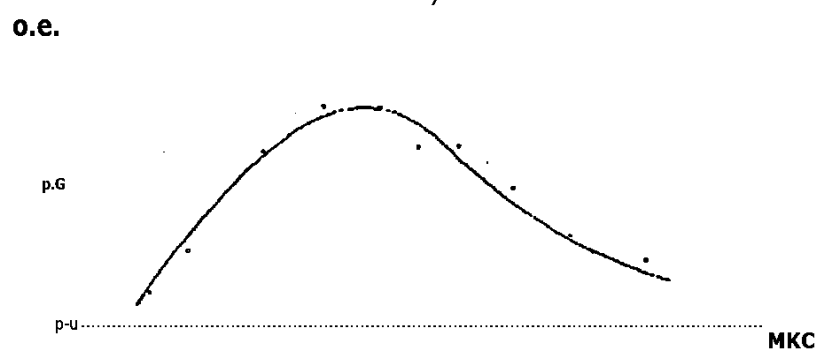
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Drawing(s) [1epTexcH]:

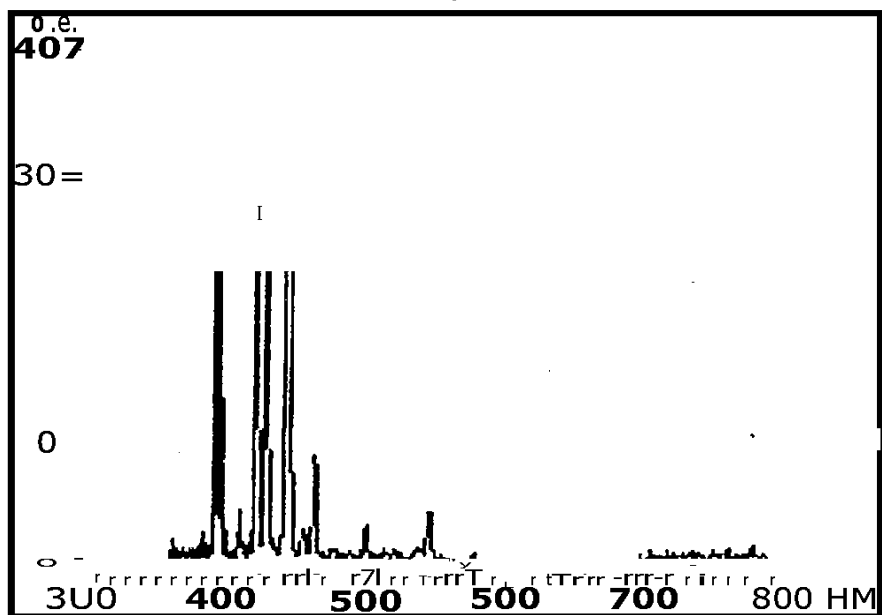
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a)



6)



B) *cpu2. I*

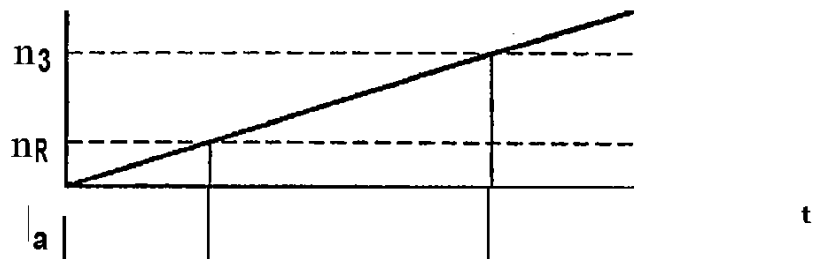
$I_{\text{н}}$

a)

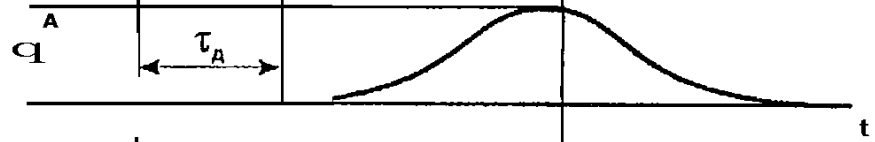


$E_{\text{н}}$

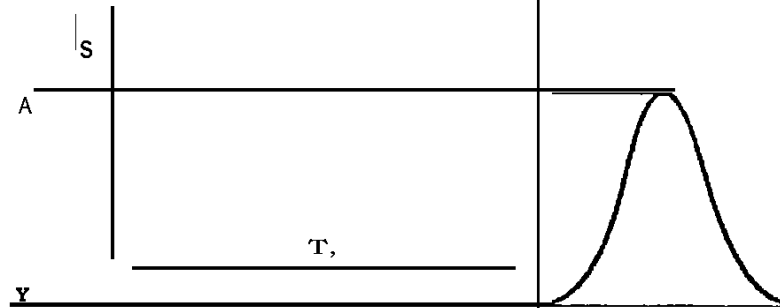
б)



в)



г)



срча 2

2

